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MY NASA DATA: Analyzing Tree Rings to Determine Climate Change

http://mynasadata.larc.nasa.gov/?page_id=474?&passid=95

Analyzing Tree Rings to Determine Climate Change

Purpose: To utilize monthly average precipitation data to strengthen conclusions about periods of drought or abnormal rainfall from analysis of tree rings

Grade Level: 6 – 8

Estimated Time for Completing Activity: 50 minutes

Learning Outcomes:

- Students will learn how to locate, access and utilize data sets to support a selected physical phenomenon.
- Students will learn how to import data into Excel and produce an appropriate graph of that data.

Prerequisite

- Completion of a lesson on tree ring structure and analysis (Three possible lessons are offered in the Lesson Links below)
- Familiarity with using Excel or other spreadsheet software
- Some knowledge of graphs and their interpretation
- General understanding of weather, particularly precipitation
- General understanding of requirements for plant growth, especially the need for water.

Tools

- Computer with Internet access
- Excel or other spreadsheet software

National Standards:

Science Content: A Science as Inquiry
Science Content: C Life Science
Science Content: D Earth and Space Science
Math: Data Analysis and Probability

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AP Environmental Science Topics
Climate shifts
Paleoclimatology

Virginia Standards of Learning:
ES.1c: The student will plan and conduct investigations in which scales, diagrams, maps, charts, graphs, tables, and profiles are constructed and interpreted.
ES.2c: The student will demonstrate scientific reasoning and logic by comparing different scientific explanations for a set of observations about the Earth.
Sci6.5: The student will investigate and understand the unique properties and characteristics of water and its roles in the natural and human-made environment.

Vocabulary:
climate
GPCP
NOAA
precipitation
weather

Lesson Links:
A Guide to Reading Tree Rings
Elementary Lesson on Tree Rings
Tree Ring Worksheet
NOAA Paleoclimatology Web Site
Live Access Server (Advanced Edition)
Jackson Tree Ring drawing
Columbia Tree Ring drawing
Boston Tree Ring drawing
Seattle Tree Ring drawing

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Background:

Researchers such as paleoclimatologists or dendrochronologists use tree ring analyses as one tool to reconstruct climate information about the past. They will often reference data from other sources such as historical weather records, and ice core or ocean core samples to support their findings.

Since the successful launch of the first weather satellite, TIROS-I in 1960, weather and climate data have been collected from space on a continual basis. More and more scientists in a wide variety of research fields are coming to rely on data gathered by these Earth observing platforms.

Tree-ring analysis is considered a method of studying precipitation that occurred during the life of the tree. In this lesson, students compare authentic precipitation data to width of tree-rings (either real or simulated) to determine similarities and differences in precipitation patterns as indicated by tree-rings, and precipitation patterns indicated by satellite data for the same time period.

Note: This lesson is designed to facilitate student acquisition of the skills and knowledge necessary for accessing and utilizing NASA data sets to further their science and math competencies while engaging them in activities that reflect the processes of scientific inquiry as conducted by individuals in a growing number of careers.

Procedure:

Part I: Collect tree-ring data

1. Gather tree-ring samples, or use the simulated tree-rings (drawings found in the Links section). Record the location of the tree and the year in which it was cut.
1a. On the tree-ring sample, carefully look at the rings in the slice. Notice that there are both dark and light rings. The light rings indicate the spring growing season, and the dark rings indicate growth in the late summer and fall seasons.
1b. To determine the age of the tree, begin counting only the dark rings from the center of the tree, working toward one edge. Count each dark ring only once. Don't count the bark (outer coating of the tree) as a ring. Record the number of rings you have counted. This corresponds to the number of years the tree was alive. To determine the year in which the tree was planted, subtract the number of dark rings from the year in which it was cut.

1c. Notice the thickness of the rings. The thickness of the rings indicates the quality of the growing conditions during that season. For example, a thicker ring would most likely indicate that water was plenteous during that growing season.
2. Complete the Worksheet for Tree Ring Analysis, Question 1 as you analyze the samples (or drawings). To complete the remainder of the worksheet, complete Part II below.

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Part II: Compare tree ring data to satellite data.

Use the following four sets of tree rings and accompanying line plots of precipitation to answer the three questions at the end of the packet.

Tree Ring 1 – Jackson Mississippi (Lat:32.299N, Lon:90.185W)

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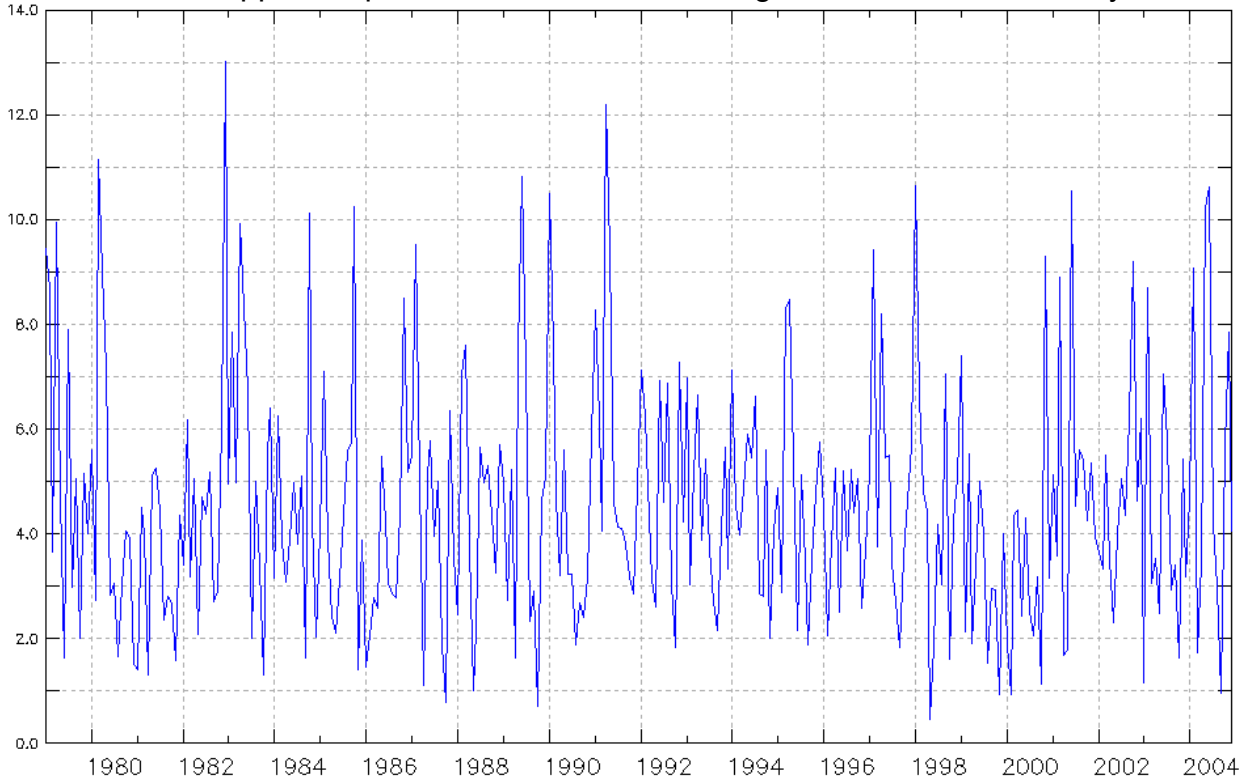
Jackson Mississippi Precipitation Plot Jan 1980 through March 2006 in mm/day



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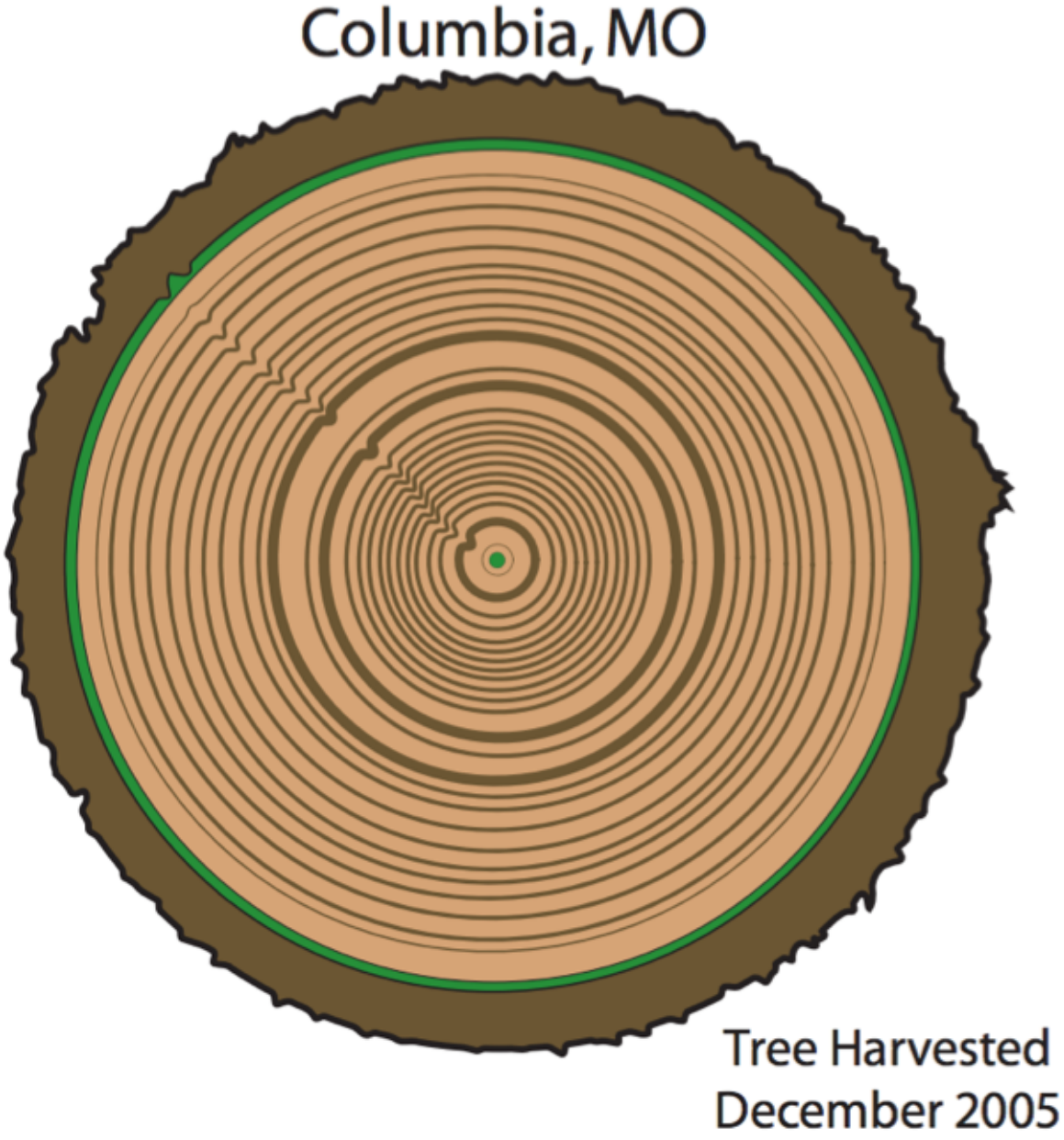
Tree Ring 2 – Columbia, Missouri (Lat:38.952N, Lon:92.334W)



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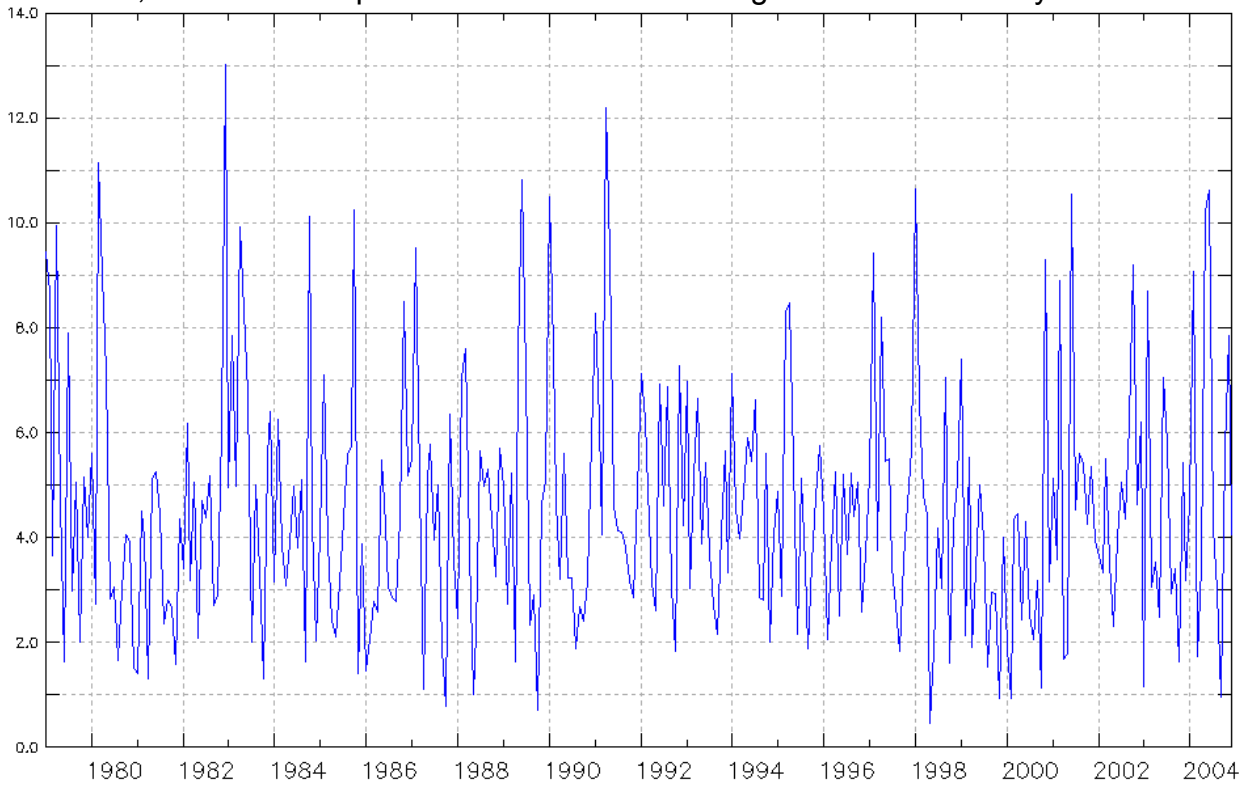
Columbia, Missouri Precipitation Plot Nov 1979 through Jan 2006 mm/day



Tree Ring 3 – Boston, Massachusetts (Lat:42.360N, Lon:71.059W)

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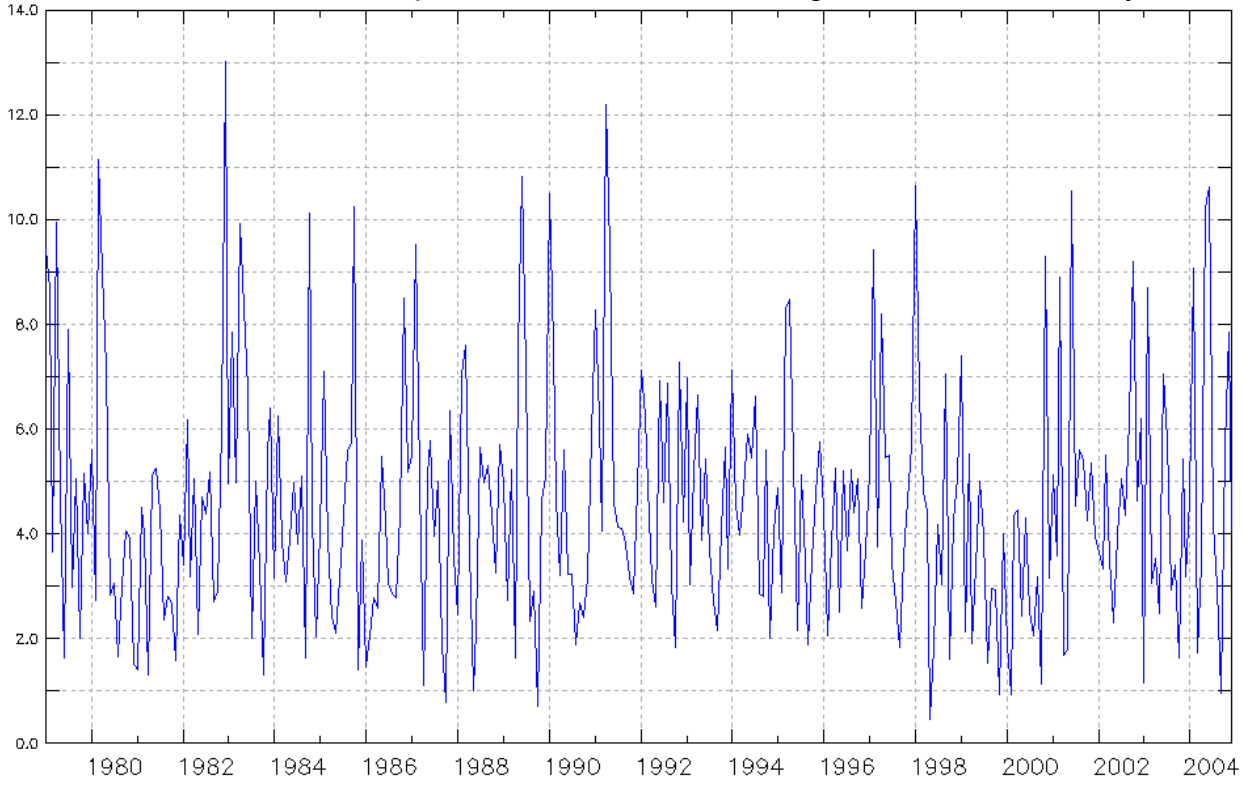
Boston, Massachusetts Precipitation Plot Feb 1980 through Jan 2001 in mm/day



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Tree Ring 4 – Seattle, Washington (Lat:47.606N, Lon:122.332W)

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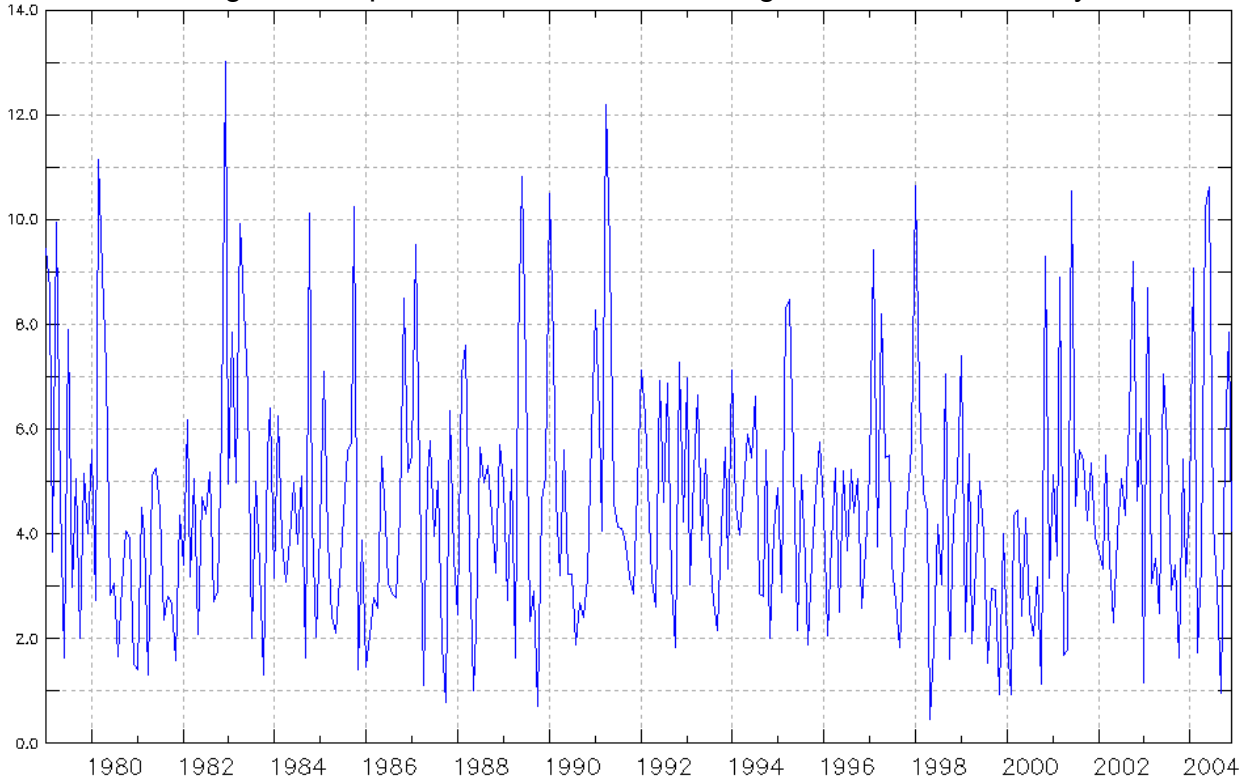
Seattle, Washington Precipitation Plot Jan 1979 through Oct 2003 in mm/day



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Questions:

1. Did the satellite data confirm your tree ring analysis? If not, what might account for the differences between the two measurements?

2. Can you suggest data sets for other parameters that you could check that might support either the tree ring or the satellite data, if they do not agree?

3. Which of your results (the tree ring analysis or the satellite data) best reflects year-long changes in precipitation? Explain your answer in terms of your data.

Extensions:

1. Have students research via news sources any strong indicators in the data of drought or exceptional periods of precipitation to determine their impact on people and the environment.

2. Expand the time range indicated in your query of the LAS and have students predict tree ring growth patterns for rings not included in the original analysis.

3. Instruct students to locate archives of publications that include past weather conditions to check on the accuracy of their predictions.

Lesson plan contributed by Patrick Daugherty, Columbia, Missouri